

## A new species in the *Ophiocoma erinaceus* complex from the South-west Pacific Ocean (Echinodermata: Ophiuroidea: Ophiocomidae)

MILENA BENAVIDES-SERRATO<sup>1</sup> AND TIMOTHY D. O'HARA<sup>2</sup>

<sup>1</sup> Echinoderms Curator, Colombian Marine Natural Museum, Institute of Marine and Coastal Research "José Benito Vives de Andreis" INVEMAR, Cerro Punta de Betín 1016, Santa Marta, Colombia (milena\_benavides@invemar.org.co)

<sup>2</sup> Museum Victoria, GPO Box 666, Melbourne, Victoria, 3001, Australia (tohara@museum.vic.gov.au)

### Abstract

Benavides-Serrato, M. and O'Hara, T.D. 2008. A new species in the *Ophiocoma erinaceus* complex from the South-west Pacific Ocean (Echinodermata: Ophiuroidea: Ophiocomidae). *Memoirs of Museum Victoria* 65: 51–56.

A new species is described from the *Ophiocoma erinaceus* complex of tropical ophiuroids, reliably distinguished by the almost complete lack of granulation on the ventral disc surface. The new species is currently known only from the south-west Pacific Ocean, ranging from the northern section of the Great Barrier Reef to Tonga.

### Keywords

Echinodermata, Ophiuroidea, *Ophiocoma*

### Introduction

Ophiuroids of the genus *Ophiocoma*, common on coral or rocky reefs throughout the tropics, are difficult to identify and many historical records are inaccurate (Devaney 1968, Devaney 1970). Part of the problem has been the lack of distinctive morphological characters and the ability of some species to change colour pattern, from being consistently dark during the day to variegated at night (Hendler 1984, O'Hara *et al.* 2004). Devaney (1968, 1970) revised the taxonomy of the genus by introducing new taxonomic characters based around the shape of the oral and dental plates and their associated papillae. However, some problems were left unresolved.

One taxonomically problematic group contains black-coloured specimens with alternating numbers of arm spines from the Indo-Pacific Ocean generally known as *Ophiocoma erinaceus* (Müller & Troschel, 1842). The concept of this 'species' has varied widely from being considered a variety of the variegated species *O. scolopendrina* Lamarck, 1816 (eg Matsumoto, 1917) to being divided into species based on the number of tentacle-scales; two in *Ophiocoma erinaceus* and one in *O. schoenleinii* Müller & Troschel, 1842 (eg see Clark & Rowe, 1971). Devaney (1970) considered them 'polymorphs of the same species having phenotypically linked morphological characters'.

Field work across northern Australia led one of the authors (O'Hara) to consider that two species were indeed present, one with red-tube feet (*O. erinaceus*) and one with grey tube feet (*O. schoenleinii*). However, subsequent pilot molecular data suggested that three clades were present: with red-tube feet and two tentacle scales (*O. erinaceus*), grey-tube feet and one wide tentacle scale (*O. schoenleinii*), and grey-tube feet and two tentacle scales (undescribed) (O'Hara *et al.*, 2004).

### Materials and methods

This paper is the formal scientific description of the third species in the complex, using a suite of morphological characters that include those of the dental plates introduced by Devaney (1970). The three known species in the complex are distinguished. Material examined for this paper is lodged in Museum Victoria, Melbourne (MV). The abbreviation d.d. is used for disc diameter.

#### *Ophiocoma cynthiae* sp. nov.

Figures 1, 2c, 2f

**Material examined.** Holotype: Queensland, Great Barrier Reef, Raine Island, shallow rocks off tower, 11°35.5'S, 144°2.3'E, 1–2 m, 5 Dec 2001, MV F112641 (ethanol, 17 mm d.d.).

Paratypes: Australia, Queensland, Great Barrier Reef, Raine Island, shallow rocks off tower, 11°35.5'S, 144°2.3'E, 1–2 m, 5 Dec 2001, MV F91535 (5 individuals, ethanol, d.d. 21 mm, 22 mm, 20 mm, 18 mm, 13 mm); Fiji, Naviti, 18°12'S, 178°11'E, 0–2 m, 7 Jul 2002, MV F101821 (1, ethanol, d.d. 21 mm); Tonga, Vaua'u, Keitahi, 18°36'S, 173°55'W, 0–2 m, 5 Oct 1983, MV F91614 (1, dry, d.d. 15 mm).

**Comparative material examined.** *Ophiocoma schoenleinii* Müller & Troschel. Australia, Queensland, Raine Island, shallow rocks off tower, 12 Dec 2001, 11°35.5'S, 144°2.3'E, 1–2 m, MV F101823 (1, ethanol, d.d. 15 mm); Moulter Cay, 11°21.4'S, 144°01.5'E, 1 m, 11 Dec 2001, MV F91534 (2, ethanol, d.d. 12 mm, 13 mm); Lizard Island, Coconut Beach, 14°40.8'S, 145°28.5'E, 2–5 m, 25 Oct 2005, MV F109814 (1, ethanol, d.d. 13 mm); Bird Island Reef, 14°4.6'S, 145°28'E, 5–15 m, 29 Oct 2005, MV F109813 (3, ethanol, d.d. 20 mm, 20 mm, 18 mm); Papua New Guinea, Bora Bada, MV F91583 (2, ethanol, d.d. 12 mm, 13 mm); Fiji, Naviti, 18°12'S, 178°11'E, 0–2 m, 7 Jul 2002, MV F93796 (1, ethanol, d.d. 20 mm); Vuda Point (between Nadi and Handtoka), 17°30'S, 177°25'E, 4 Jul 1981, MV F91593 (2, dry, d.d. 13

mm, 17 mm). *Ophiocoma erinaceus* Müller & Troschel. Western Australia, Ashmore reef, West lagoon, 12°14.29'S, 123°0.77'E, 3–9 m, 2 Oct 2002, MV F93633 (1, ethanol, d.d. 18 mm); Ashmore reef, west lagoon, 12°13.26'S, 122°59.28'E, 6–11 m, 1 Oct 2002, MV F93624 (5, ethanol, d.d. 13 mm, 11 mm, 13 mm, 6 mm, 5 mm); Queensland, Raine Island, shallow rocks off tower, 11°35.5'S, 144°2.3'E, 1–2 m, 5 Dec 2001, F91536 (2, ethanol, d.d. 15 mm, 20 mm); Moulter Cay, reef rim, 11°24.8'S, 144°01.9'E, 1–5 m, 10 Dec 2001, MV F91544 (1, ethanol); Lizard Island, First beach, 14°39.7'S, 145°26.8'E, 2–4 m, 28 Oct 2005, MV F109808 (1, ethanol, d.d. 19 mm).

**Description.** Holotype. Disc 17 mm d.d., pentagonal with slightly incised interradiar margins. Dorsal disc densely covered with rounded granules 0.15 mm diameter, 13–20 per mm<sup>2</sup>, sparse or patchy near the arms bases and interradiar margins, covering radial shields. Ventral disc without granules,

covered in thick wrinkled epithelium, disc plates obscured; a few elongated spinelets occur in a row on either side of the genital slit adjacent to the oral shields.

Oral shields oval, longer (2.2 mm) than broad (1.9 mm), widest point a little distal of the midline, slightly depressed in the distal centre. Adoral shields triangular, much smaller than the oral shield, slightly lobed radial angle, restricted to the lateral edge of the oral shield, not meeting radially or interradially, margins obscured by epidermis (Fig. 1c). Four oral papillae on each side of jaw angle; inner is spiniform, twice as high as wide; second is triangular, wider than high; third is largest, two to three times as wide as high, longest proximally; last (buccal tentacle scale) is wide and low, up to four times as wide as high, proximal end extending under the third oral papilla. Ten to 11 dental

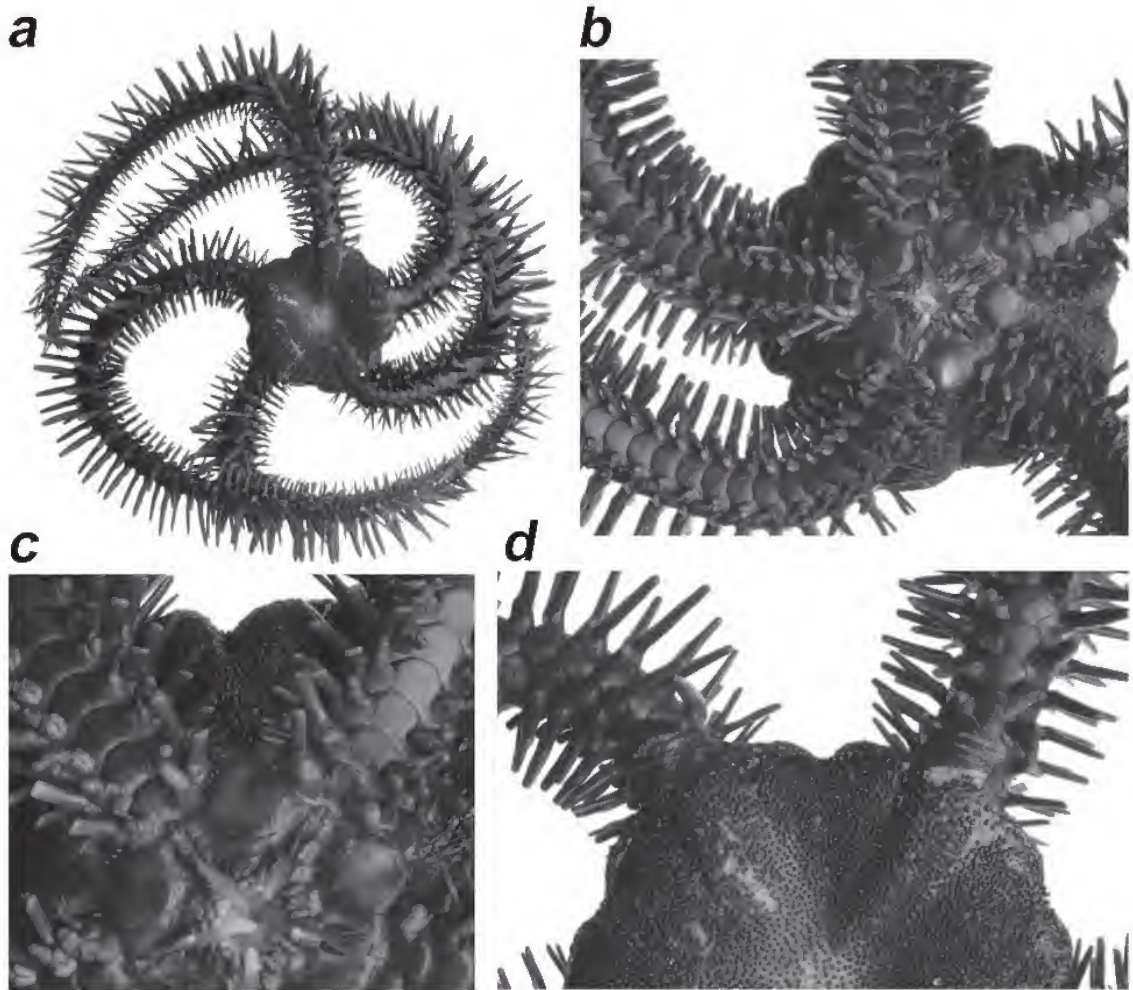


Figure 1. *Ophiocoma cynthiae* sp. nov. holotype (22 mm d.d.): a, dorsal surface of the whole animal; b, ventral surface; c, detail of oral frame; d, detail of the dorsal disc and arm surfaces.



Figure 2. Dental plates of *Ophiocoma erinaceus* (MV F109808, 22 mm d.d.): a, external surface, d, internal, *Ophiocoma schoenleinii* (MV F109813, 21 mm d.d.): b, external; e, internal. *Ophiocoma cynthiae* sp. nov. (MV F91535, paratype 22 mm d.d.): c, external; f, internal.



papillae on each jaw, placed in three vertical rows near teeth, inner row slightly smaller, and an irregular transverse row or cluster across the jaw margin between the inner oral papillae; four hyaline tipped teeth in a vertical row, twice as wide as high.

First ventral arm plate much smaller than succeeding plates, with a straight or rounded proximal margin, straight to convex lateral sides and a convex distal margin, longitudinally grooved; second plate as wide as long, widest distally, with a convex distal edge, rounded lateral angles, recurved lateral sides and truncate proximal edge, often sunken proximally so that the distal edge of the first plate projects over the proximal edge of the second; succeeding plates 1.5 times broader than long, widest in the distal half of the plate, convex distal margin, sharp lateral angles, recurved lateral sides around tentacle pore, concave proximal edge overlain by preceding plate, plates in contact for more than half of arm length. Upper arm plates fan-shaped, usually wider than long, with a convex to truncate distal margin, straight divergent lateral sides and a slightly concave proximal border overlain by the preceding plate, plates contiguous throughout the arm, plates forming a zig-zag row after the fifth segment past the disc, displaced away from the enlarged alternating upper arm spines. Lateral arm plates separated from each other for all arm length.

Number of arm spines on each side of first twenty segments as follows (clockwise from the madreporite):

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 3 | 4 |
| 3 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 | 3 |
| 3 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 |
| 3 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 | 3 |
| 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 3 | 4 | 3 | 4 | 3 | 4 |
| 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 | 3 |
| 2 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 4 |
| 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 |
| 2 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 |
| 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 |

Arm spines of the first 5–7 segments flattened or curved, with truncate tips, subequal or uppermost longest, mostly longer than the ventral arm plate (except on first segment); spines on succeeding segments becoming progressively more cylindrical; spines start alternating 3–4 after segments 12–16, alternating uppermost spines become elongated and thickened, cigar- to club-shaped, longest in the middle of the arm, to three segments in length, 4–4.5 mm long, lower spines elongate and tapering; distal arm segments with three slender non-alternating spines. Two oval subequal tentacle scales on each pore, sitting side by side on the lateral arm plate, reducing to one near the arm tips.

**Colour.** Ethanol: Disc and arms uniform dark brown colour. Upper side spines of five first segments of arm spines with some white longitudinal bands along the edge; tube feet dark, with a pale tip near the mouth, oral tentacles pale; mouth frame basically tan with small dark spots, madreporite white.

**Paratypes.** A dental plate, dissected from one paratype (F91535, 22 mm d.d., Fig 2c), was 4.9 mm long and 1.7 mm wide, with

two foramina, the lower septa twice as thick as the upper one, and dental papillae confined to the upper third of the plate, which is slightly narrower than the rest of the plate. Paratypes generally had more elongate granules or spinelets along the genital slit, extending to 1/2R. On paratype F91614 the dorsal disc granules form a very regular sharp boundary at the edge of the disc and (since it is preserved dry) small thin overlapping ventral disc scales (0.20–0.25 mm wide) can be clearly seen extending from the lateral margin to the oral shield. The second oral papillae can sometimes be larger than the third, but this is not consistent on a specimen. There can be up to 17 dental papillae. Paratype F101821 differs in having ventral arm plates with a concave or slightly notched distal margin except near the arm tip, the dorsal arm plates are regularly arranged in a series, not alternating from side to side, and the maximum arm spine length is 8.6 mm. Paratypes F101821 and F91614 from Fiji and Tonga respectively, have a lighter colour than the holotype and paratypes (F91535) from Australia, the mouth frame is white and the arms have broad bands of dark and pale segments. This may represent the “night” colour form.

**Distribution.** Northern Great Barrier Reef, Fiji, Tonga, 0–2 m; under coral slabs or within dead coral matrix.

**Etymology.** This species is named after friend and tireless colleague Cynthia Ahearn, the former Museum Specialist in Echinoderms at the Smithsonian Institution who passed away in August 2008.

**Remarks.** The new species is clearly an *Ophiocoma* Agassiz as defined by Devaney (1970), possessing both dental and oral papillae, the latter in a continuous row, small adoral plates restricted to the lateral sides of the oral plate, a covering of spherical granules on the dorsal disc surface, and rounded arm spines in the middle of the arm. It belongs to the ‘scolopendrina’ group of species (Devaney 1970) with alternating numbers of arm spines and the uppermost arm spine enlarged. Within this group it shares many features in common with *O. erinaceus* including the dark colour, the presence of two to three arm spines on the first segment, the coarse disc granulation (10–20 per mm<sup>2</sup>) and the size of the upper arm spines, which are longer on the side with four spines.

Within, the *O. erinaceus* complex, *O. cynthiae* is distinguished by the lack of granules on the ventral disc surface (except for a few sparsely distributed along the genital slit near the oral shield). In *O. schoenleinii* they persist as a wedge near the ventral margin and extend almost to the oral shields in *O. erinaceus*. Furthermore, *O. schoenleinii* is distinguished by having only one wide tentacle scale on most pores past the first few segments, and denser dorsal disc granules (>20 per mm<sup>2</sup>). *Ophiocoma erinaceus* can be further distinguished by the colour of the tube feet: bright red in live specimens and white in ethanol-preserved ones.

Comparison of the dental plates of the three species (Fig. 2) indicates other possible differentiating characters. The dental plate of the new species is somewhat larger on specimens of similar size (21–22 mm d.d.), and is less narrowed on the region supporting the dental papillae. There are only two teeth foramina and the septum of second is much wider than the

first. The dental plates of the other two species have three foramina, but the third is much larger on *O. schoenleinii*. However, due to the low numbers of specimens of the new species we are reluctant to dissect additional material and the intraspecific or size-related variability of these characters is unknown at this stage.

This new species is similar to the description of the nominal species *Ophiocoma tartarea* Lyman, 1861, from Hawaii which was considered a synonym of *O. erinaceus* four years later by the same author (Lyman, 1865). In both his description of *O. tartarea* (1861) and *O. erinaceus* (1865) he refers to the absence of granules on the ventral disc surface, but without distinguishing between a wedge of granules and no granules at all. We have examined images of Müller & Troschel's type specimens in the Museum für Naturkunde Humboldt-Universität zu Berlin of both *O. erinaceus* (ZMB Ech 922) and *O. schoenleinii* (ZMB Ech 930, 4658). The type specimen of *O. erinaceus* clearly has a wedge of granules on the ventral interradial margin. The type specimens of *O. tartarea* appear to be lost. They were originally deposited in the museum of the Boston Society of Natural History (now called the Museum of Science), which transferred the majority of their collection in the 1940s to the Museum of Comparative Zoology in Harvard and some specimens to the United States National Museum. Downey (1969) does not list this species in her catalogue of US ophiuroid-type specimens, and there is no record of them in these museums today (Kirdahy, Ahearn & Boyett pers. comm.). Given the lack of available type material, the early synonymy of *O. tartarea* with *O. erinaceus* by the same author, and the lack of known records of specimens without any ventral granules from Hawaii, we proposed to erect a new species, *O. cynthiae*.

### Acknowledgments

We would like to thank Chris Rowley (Museum Victoria) for taking the camera images of the new species; Joan Clark (University of Melbourne) and Kate Naughton (Museum Victoria) for assisting with the SEMs; Dr Carsten Lueter (Museum für Naturkunde, Humboldt-Universität zu Berlin) for providing images of type specimens of *Ophiocoma erinaceus* and *O. schoenleinii*; Carolyn Kirdahy (Boston Museum of Science), Cynthia Ahearn (formerly of the United

States National Museum) and Mary Catherine Boyett (Museum of Comparative Zoology, Harvard) for attempting to trace the type specimens of *Ophiocoma tartarea*; the Raine Island Corporation and Environment Australia for supporting the fieldwork to Raine Island and Ashmore Reef; Dr Maria Byrne and Mark O'Loughlin for collecting material from Fiji and Tonga respectively.

### References

- Clark, A.M. & Rowe, F.W.E. 1971. *Monograph of Shallow-water Indo-west Pacific Echinoderms*. Trustees of the British Museum (Natural History). London. 238 pp, 31 pls.
- Devaney, D.M. 1968. The systematics and Post-Larval growth changes in Ophiocomid brittlestars. PhD thesis. University of Hawaii. 272 pp.
- Devaney, D.M. 1970. Studies on ophiocomid brittlestars. I. A new genus (*Clarkcoma*) of Ophiocominae with a reevaluation of the genus *Ophiocoma*. *Smithsonian Contribution to Zoology* 51: 1–41.
- Downey, M.E. (1969). Catalog of recent ophiuroid type specimens in major collections in the United States. *Bulletin of the United States National Museum* 293: 1–239.
- Hendler, G. 1984. Brittlestar colour-change and phototaxis (Echinodermata: Ophiuroidea: Ophiocomidae). *Pubblicazioni Della Stazione Zoologica Di Napoli I (Marine Ecology)* 5: 379–401.
- Lyman, T. (1861). Descriptions of new Ophiuridae. *Proceedings of the Boston Society of Natural History* 8: 75–86.
- Lyman, T. (1865). Ophiuridae and Astrophytidae. *Illustrated Catalogue of the Museum of Comparative Zoology, Harvard University* 1: 1–200, pls 1–2.
- Matsumoto, H. (1917). A monograph of Japanese Ophiuroidea, arranged according to a new classification. *Journal of the College of Science, Imperial University Tokyo* 38(2): 1–408, pls 1–7.
- Müller, J. & Troschel, F.H. 1842. *System der Asteriden*. Von Friedrich Vieweg und Sohn, Braunschweig. 134 pp., 12 pls.
- O'Hara, T.D., Byrne, M., & Cisternas, P. 2004. The *Ophiocoma erinaceus* complex: another case of cryptic speciation in echinoderms: pp. 537–42 in Heinzeller, T. & Nebelsick, J.H. (eds). *Echinoderms: München: Proceedings of the 11th International Echinoderm Conference, Munich, Germany, 6–10 October 2003*, A.A. Balkema, The Netherlands.

